A novel approach to mammographic breast compression: improved standardization and reduced discomfort by controlling pressure instead of force

J.E. de Groot; M.J.M. Broeders; W. Branderhorst; G.J. den Heeten; C.A. Grimbergen

Concise abstract:

Purpose: In X-ray mammography, flattening of the breast improves image quality and reduces absorbed dose. Current mammographic compression guidelines are based on applying a standardized force to each breast. Because breast size is not taken into consideration, this approach leads to large variations in applied pressure (force applied per unit contact area). It is our hypothesis that a pressure-controlled compression protocol, which takes contact area into account, 1) improves standardization across the population in terms of physiological conditions in the compressed breast (blood pressure), and 2) reduces discomfort and pain, particularly the number of severe pain complaints, 3) with limited effects on image quality and absorbed glandular dose (AGD).

Methods: A prospective observational study including 291 craniocaudal (CC) and 299 mediolateral oblique (MLO) breast compressions in 196 women following our hospital’s standard compression protocol with 18 decanewton (daN) target force was performed. Breast thickness, applied force, area of contact between breast and compression paddle, and mean pressure were recorded during the entire compression. Pain scores were obtained using an 11-point Numerical Rating Scale (NRS). We analyzed differences between the CC and MLO compressions, correlation coefficients ($\rho$) between compression parameters, and odds-ratios (OR) for all parameters as possible predictors for experiencing severe pain using multivariate logistic regression. The observed data were used to estimate what breast thickness, required force and pain score would be for pressure-controlled compression protocols with target pressures ranging from 4 to 28 kilopascal (kPa).

Results: In a standard 18 daN force-controlled compression protocol, we observed an average pressure of 21.3 kPa ± 54 % standard deviation for CC compressions and 14.2 kPa ± 32 % for MLO compressions. Women with smaller breasts endured higher pressures and experienced more pain. Multivariate regression showed that contact area is a strong and significant predictor for severe pain. Model estimations showed that mammographic breast compression with a standardized pressure of 10 kPa, corresponding to less than normal diastolic blood pressure, may significantly reduce the number of severe pain complaints.

Conclusions: Model estimations and an observer study showed that pressure-controlled mammographic compression protocols may improve standardization and reduce discomfort with limited effects on image quality and AGD.

After publication in the Medical Physics journal, a link to the article will be provided